Pork Industry Handbook: Composition and Nutritive Value of Pork
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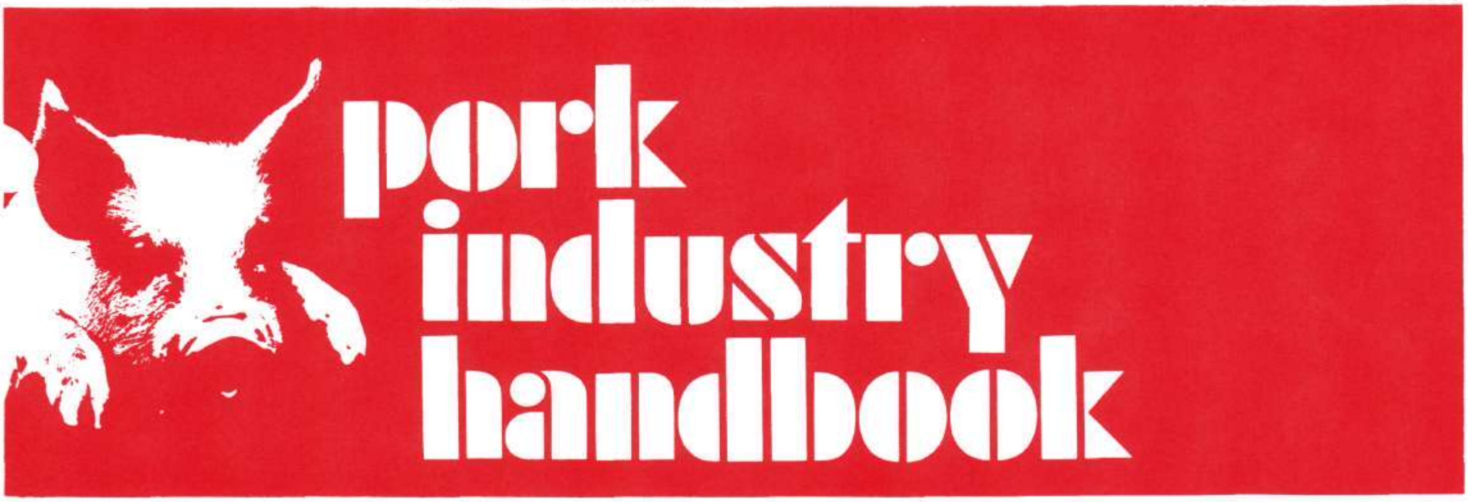

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

Composition and Nutritive Value of Pork

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Human use of pork as a food dates back to prehistoric times. Drawings on the walls of caves in Europe portray wild pigs being hunted even before the development of a written language. As civilization advanced and animals were domesticated to provide for a more predictable and consistent food supply, the pig was highly valued as a source of very palatable human food. For the ensuing centuries, a number of societies have placed a heavy reliance on pork as a major dietary component, and it has served them well as a source of major nutrients.

"Fat as a pig" was, for centuries, an apt description for one who was overweight. However, over the past thirty or forty years improvements in leanness achieved through genetic means and the development of improved feeding and other management regimes have resulted in a much leaner profile for the typical pig. As a result, the pig has generally become much leaner since World War II. In the modern era, there have been a number of consumer-driven changes in pork production. In responding to emerging consumer demands, the pork industry, shortly after World War II, began to modify pork composition by reducing its fatness with corresponding increases in leanness and all that this implies. Consumers have become much more diet conscious with emphasis on nutrition and health, but still are very interested in the traditional quality attributes of flavor, tenderness, juiciness and texture that pork provides.

Common wisdom suggests that pork produces a high level of appetite satiation, or a feeling of appetite satisfaction. Simonson (1982) reports that persons on a meat-containing diet compared to those on either a self-designed vegetarian diet or on diets individually designed for them by a professional dietitian, lost weight more slowly. However, the persons who were on a non-vegetarian diet had less weight fluctuation, fewer dropouts, no feeling of hunger, experienced few physical and psychological problems and had improved work productivity. This generally supports the contention that meat consumption, including pork, provides a good level of appetite satisfaction.

The pork producer has increasingly recognized his role in supplying human food and the responsibility that this recognition brings with it, and of the increasing need to keep abreast of changing consumer needs and desires. Producers have, therefore, become much more aware of the validity of the desire by consumers for a healthier and a safer diet. Recognizing the corresponding increases in demand for reasonably priced "healthy" meat, requiring a minimum of time and effort in the kitchen, has spawned a number of new products using pork as a raw material. The development of scientific parameters, and the use of computers, has permitted the industry to more consistently produce products which are more finely attuned to existing and emerging consumer desires and demands. Such developments have resulted in a triumph for hog producers and resulted in the development of a hog that is both "producer" and "consumer" friendly.

Table 1. Lean, fat, bone and skin of primal cuts expressed as a % of total carcass lean, fat, bone and skin respectively.*

	Lean	Fat	Bone	Skin	Total primal cut
Leg (ham)	28.8	14.5	17.6	12.0	21.5
Loin	24.2	6.7	25.6	--	17.0
Blade Boston	13.9	5.1	4.2	--	8.7
Arm picnic	11.4	6.0	11.6	8.8	9.5
Belly	9.7	16.0	--	15.0	10.6
Jowl, spareribs, Neck bones, feet and tail	7.4	6.5	41.0	15.5	11.6
Non-specific cut/trim	4.7	45.2	--	48.8	21.1
TOTALS	100.1	100.0	100.0	100.1	100.0

*Source: Forrest (1989).

Composition

The primary tissues which constitute pork include lean, fat, bone and soft connective tissue. The paramount reason, however, for raising pigs in the modern era, is the ability of the pig to convert plant materials to lean tissue for use as a human food. The lean tissue must obviously contain sufficient intramuscular fat to insure acceptable taste appeal. While many of the other components of the animal contribute significantly to its economic value, we must not lose sight of the primary role of the pig in the food supply chain, namely the production of lean tissue. Table 1 provides composition information relative to the contribution of the various tissues to the traditional primal cuts.

A hot, (pre-rigor) pork carcass weighing 172 pounds would be expected to have originated from a live hog weighing about 235 pounds. Typically that carcass might be expected to have a backfat thickness at the 10th rib of about 1.3 in. and a loin eye area of about 4.5 sq. in. According to Forrest et al. (1989) that typical pork carcass contains about 48 to 50% of its weight in the form of knife-separable lean, about 32 to 33% in knife-separable fat, about 5 to 6% skin and about 1.5 to 2.0% shrink or product unaccounted for. The authors estimate this separable lean to consist of about 10% extractable lipids and 19 to 20% protein based on Anderson (1983). Anderson (1983) also reports the trimmable fat tissue to contain 4.5 to 5.0% protein and about 76% extractable lipids. One can then conclude that the total soft tissue contains about 36 to 37% extractable fat and 13 to 14% protein. One can also conclude that this 235 lb. pig produces a 172 lb. carcass before chilling and that it contains about 80 to 84 lb. of chilled separable lean.

Table 2 presents the fat content/100 g of lean tissue on a raw basis (g/100g separable lean) as well as g/85g cooked separable-lean tissue. The Atwater conversion factor to convert lipids to energy is 9.02 kcal/g of lipids and 4.27 kcals/g in the case of protein, according to Anderson (1983). Thus in 85g (3 oz.) of cooked lean from the primal cuts, they range from 87 kcals originating from fat, out of a total of 187 kcals for the lean of the fresh leg (ham), to 148 from fat out of a total of 235 kcals from a serving of cooked lean from the blade portion of the loin.

The absolute fat content of the lean is higher for cooked than for raw tissue. This is believed to be due to two factors: 1) the weight reduction in cooking brought about by moisture losses and 2) the transfer of subcutaneous or intermuscular fat following rendering which occurs during the cooking process. It is believed that this rendered fat invades the lean tissue and thus becomes a part of the cooked lean, insofar as extractable fat is concerned. It may well be useful, therefore, to remove fat tissue before cooking as a means of reducing the contribution of pork lean to dietary fat.

Table 2. Extractable fat content of fresh pork.*

Tissue origin, Primal cut	Raw pork lean only g/100 g tissue	Cooked pork, lean only g of fat/3 oz serving			
		Braised	Broiled	Pan fried	Roasted
Leg (ham), whole	5.41	--	--	--	9.4
Loin, sirloin	6.75	11.1	11.5	--	11.2
center loin	7.15	11.6	8.9	13.5	11.1
center rib	7.53	12.3	12.7	13.0	11.7
blade	11.03	17.5	18.2	16.9	16.4
whole	7.54	12.4	13.0	--	11.8
Blade Boston	9.28	15.0	15.7	--	14.3
Arm picnic	6.16	10.4	--	--	10.7
Spareribs	23.60	25.8	--	--	--

*Source -- Anderson (1983) - USDA HB 8-10.

Nutritive Value

Challenges to the inclusion of pork in the U.S. diet are concentrated on its fat, saturated fatty acids, cholesterol and sometimes on its sodium content. Most of the reputable dietary guidelines, according to the National Research Council (1988), recommend curtailing human consumption of fat so that it contributes no more than 30% of caloric intake and that saturated fatty acid intake be limited to less than 10% of caloric intake. It is then further recommended that dietary cholesterol be limited to an average of not more than 300 mg/day. Finally, the safe and adequate intake of sodium of 1100 to 3300 mg per person per day (equivalent to about 2.8 to 8.5g of salt per day) is also typically recommended. Table 2 presents the lipid content for a 3 oz. serving of a number of cuts of fresh pork as reported by Anderson (1983). The fresh leg and the loin cuts, with the possible exception of the blade portion of the loin, and the Blade Boston would certainly be acceptable in fat content to most American consumers. Fatty acid profiles derived from Slover, et al. (1987) shown in Table 3, indicate that saturated fatty acids (SFA's) constitute less than 40% of the fatty acids of all except one of the major pork cuts. Of the major pork cuts presented in Table 3, the caloric contribution provided by fat ranges from a low of 84

Table 3. Fatty acid profile[1] of cooked pork lean.

Primal cut of lean tissue origin	Components of 3 oz cooked lean		Fatty acids (FA's)[2] Expressed as a % of total FA's			
	Total lipids g	Total fatty acids g	MUFA's[3]	PUFA's[4]	SFA's[5]	SFA's-stearic acid
Leg, rump portion	9.47	8.79	48.4	11.1	37.3	25.5
Shank portion	9.28	8.61	50.9	9.9	36.1	24.7
Loin, sirloin roast	11.24	10.29	47.5	10.4	39.0	26.4
Rib chops, broiled	12.08	11.42	49.9	9.3	39.2	26.5
Blade roast	16.61	15.79	47.9	8.9	40.7	26.8
Blade Boston						
Steak braised,	15.34	14.03	47.7	9.5	39.6	26.0
Arm picnic roast	10.63	10.18	50.1	10.0	36.7	24.9

[1] Source - Slover et. al (1987).
[2] FA's = Fatty Acids
[3] MUFA's = Monounsaturated Fatty Acids
[4] PUFA's = Polyunsaturated Fatty Acids
[5] SFA's = Saturated Fatty Acids

calories to a high of 148 kcals per 3 oz. serving. Spare ribs is an exception in that it provides 233 kcals per 3 oz. serving of cooked lean and fat. If one were on a diet which provided 2000 kcals/day, the fat in a 3 oz. serving of cooked lean from the primary cuts, would provide between 4.25 and 7.5% of the caloric requirements. From the data presented in Table 3, one can determine that saturated fatty acids provide between 33 kcals and 68 kcals per 3 oz. serving of cooked pork lean. On the premise that stearic acid does not elevate serum cholesterol, as reported by Bonanome and Grundy (1988), the caloric contribution of SFA's that may elevate serum cholesterol is reduced to a range of 24-45 kcals.

Fresh pork is a nutrient-dense food, meaning simply that it makes a greater contribution to a number of nutrient needs than to the energy requirements. In the case of pork in the 2000 kcal diet, it is nutrient-dense for an adult male with regard to protein, iron, zinc, thiamin, riboflavin, niacin and vitamin B12. Thus one can properly describe pork as a very nutritious food in that it is nutrient dense in more than four nutrients.

Pork is a versatile food, and a high proportion of pork is consumed as processed meat. It is therefore, important to look also at the processed meat component of the diet. Pork is a popular meat for about 85% of the U.S. population. While The National Livestock and Meat Board estimates that only 12-15% of beef and lamb is eaten in processed form, between 65 and 75% of pork is eaten in the cured and processed state according to Breidenstein and Williams (1986)–with the remainder eaten as fresh. The contribution of fresh pork to nutrient needs is well supported by the nutrient profiles for fresh pork lean contained in Table 4 as is true for processed pork as well.

Table 4. Nutrient profile of pork as perceived to be ingested.

Item	100 g			Avg. daily nutrient
	Fresh	Processed	Composite*	contribution**
Kcals	266.88	278.00	275.32	119.65
Protein, g	27.37	16.29	18.96	8.24
Lipids, g	16.61	22.62	21.17	9.20
Cholesterol, mg	96.12	57.00	66.44	28.88
Iron, mg	1.18	1.61	1.51	0.65
Zinc, mg	3.32	1.98	2.30	1.00
Sodium, mg	71.23	1077.00	834.21	362.55
Thiamin, mg	0.79	0.41	0.50	0.22
Riboflavin, mg	0.38	0.21	0.25	0.11
Niacin, mg	5.54	3.62	4.09	1.78
Vitamin B12, mcg	0.95	1.15	1.10	0.48

*Derived by (Fresh Profile x 0.2414) + (Processed Profile x 0.7586).

**Based on daily ingestion of fresh and processed pork.

Pork Consumption

The composite of consumed pork in the United States in 1987 is presented in Table 4. Americans ingested about 1.5 oz. of pork per person per day in a combination of fresh and processed forms. Of that total the authors perceive that about 25% was consumed as fresh product, whereas, the remaining 75% was consumed as processed meat. In such a composite, as Table 4 shows, pork remains a nutrient dense food in a 2000 kcal diet, providing only 6% of that daily energy need. In this regard, pork contributes a higher percentage of the required iron, zinc, thiamin, riboflavin, niacin, vitamin B12 and protein than its contribution to those energy needs.

Summary

The pig, as a member of the human food chain, has evolved into a highly efficient converter of grains and other plant source materials into foods which are very nutritious and also highly satisfying to the human palate. The most obvious change which has occurred over the past four decades has been the increased leanness of the animal. As plant-source edible oils have become much more available and at very economical prices, the demand that the pig produce edible food fats has been dramatically reduced. The consumer demand for lower fat meats has also helped accelerate this trend. Kauffman and Breidenstein (1983) have estimated that the pig has increased in leanness by about 23%. Others have estimated the improvement to be even greater. The highly important characteristic about this change is that it has occurred while retaining the eating qualities expected by the consumer. Thus, the pork producer can take great justifiable pride in producing food that is truly "consumer friendly."

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